2019

The Effect of a Simulation-Based Education Program on NIHSS Accuracy and Inter-Rater Reliability Among Nursing Staff in the Neurological/Neurosurgical Intensive Care Unit

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Amanda Novak, Student

Dr. Carol Thompson, Advisor

DNP Final Project Report

The Effect of a Simulation-Based Education Program on NIHSS Accuracy and Inter-Rater Reliability Among Nursing Staff in the Neurological/Neurosurgical Intensive Care Unit

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Spring 2019

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Dedication

My DNP project in its entirety is dedicated to my family, whose unconditional love and support has made the attainment of a Doctor of Nursing Practice possible. To my mom, Sharon, thank you for being my constant stronghold and best friend – it is you who have carried me through the most challenging of days. To nanny, you and gramps have supported me more than you know throughout the years, and for that I am truly grateful. To Barry, thank you for assuming a pivotal role in my life when I needed it most – you are the best “bonus” dad a girl could have. To my sister, Emily, I hope this inspires you as you work to achieve a doctoral degree of your own. Lastly, to my late father, Thomas, thank you for always believing there was greatness in me, even when I did not see it myself.

Acknowledgements

I would like to acknowledge the following people for their assistance during my time in the DNP program, as well as aiding in various aspects of this project:

Dr. Carol Thompson (committee chair/academic advisor): for her continuous support and guidance over the past three years, for all the time she spent reviewing and critiquing my work, and for her dedication to the education of future nurse practitioners.

Dr. Jennifer Dent (committee member): for her support throughout the duration of my project and for aiding her expertise in simulation.

Dr. Nicholas Welker (committee member/clinical mentor): for being a wonderful mentor and friend, for showing me what it takes to be an exemplary provider, and for his sheer dedication to educating others.

Dr. Brockopp (clinical research associate): for her assistance in guiding me through the rigorous IRB process and providing me a wealth of knowledge in regard to the realm of research.

Alyssa Clements-Hickman (data analyst): for her assistance with the organization and analysis of data.

Natalie Anderson (participating clinician): for assisting me in the development of my NIHSS scenarios and serving as an expert in determining correct scores.

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Abstract

PURPOSE: The purpose of this Quasi-experimental study was to examine the effect of a simulation-based educational NIHSS workshop on nursing accuracy and inter-rater reliability upon use of the National Institutes of Health Stroke Scale (NIHSS).

METHODS: This study was conducted in the Neurological/Neurosurgical Intensive Care Unit (ICU) at Baptist Health, a comprehensive stroke center located in Lexington, KY. The sample included 26 eligible nurses employed in the aforesaid unit. Nurses completed the NIHSS on a patient actor in a simulated scenario (this session was videotaped), a one-on-one debriefing with review of the videotape was conducted afterward, and then the nurse completed the NIHSS on a patient actor in a second scenario.

RESULTS: Four participants scored the patient correctly in scenario one, and nineteen participants scored the patient correctly in scenario two. However, the results were not deemed statistically significant ($P=.287$, Fisher's Exact Test). Variability of scoring did improve from scenario 1 to scenario 2 ($SD=1.74$ and 0.53, respectively). Inter-rater reliability among participants was also shown to increase in scenario 2, with noted differences in five items on the NIHSS.

CONCLUSION: NIHSS simulation-based education was shown to improve accuracy of scoring ($SD=1.74$ pre-intervention and $SD=0.53$ post-intervention) and inter-rater reliability (significant results seen in five distinct scale items) of participants. More research is needed to determine if simulation-based NIHSS education has an effect on patient outcomes.

Introduction

Despite certification, nurses continue to demonstrate a lack of confidence and inaccurate patient scoring upon use of the National Institutes of Health Stroke Scale (NIHSS; see Figure 1). This problem is significant enough that researchers have examined the issue. For example, O'Farrell and Zou (2008) found that a nurse's confidence increased immediately ($p < .0001$) upon being trained in the NIHSS and then decreased approximately three months later ($p = .07$). Furthermore, a study analyzing NIHSS scoring of patients 3 months after initial certification showed that as time increased, rater reliability decreased (ICC = .94 and .92, respectively) – this was called the “drift effect” (Goldstein & Samsa, 2001). This issue affects all patients presenting with acute stroke symptoms and can lead to inappropriate treatment strategies, especially for those patients in which Recombinant Tissue Plasminogen Activator (rtPA) is considered. Recombinant Tissue Plasminogen Activator is the most common treatment for ischemic stroke, recommended by both the American Heart Association (AHA) and American Stroke Association (ASA) per the Intravenous Fibrinolysis Guideline.

The AHA/ASA Intravenous Fibrinolysis guideline is utilized to determine appropriate treatment strategies for those presenting with an ischemic stroke. This guideline was recently revised and still recommends the NIHSS to be used as the primary stroke severity rating scale to determine therapy (Powers et al., 2018). The guideline states that relative exclusion criteria for rtPA include isolated or minor neurological deficits (NIHSS ≤ 4), rapidly improving symptoms, and severe stroke (NIHSS >25) for those within the 3 to 4.5-hour window (Hacke et al., 2008). If staff are not competent and consistent in scoring patients using the NIHSS, it creates the potential for inappropriate treatment strategies. For example, if a nurse scores the patient a 2 on the NIHSS when they are actually a 6 they may not receive rtPA - which would have been the most appropriate treatment. This could potentially result in the patient experiencing lasting deficits from their stroke (which could have easily been resolved with rtPA) and even poorer outcomes depending on the degree of their disability.

The root cause of this problem is likely related to limited use of the NIHSS in certain practice areas and the increase in time from when the individual received NIHSS certification (Golstein & Samsa, 2001; O'Farrell & Zou, 2008). A proposed solution to this issue is routine NIHSS education performed at regular intervals in order to maintain scoring accuracy and inter-rater reliability. There is extensive research supporting the use of simulation-based education to train medical staff (Abas & Juma, 2016; Sørensen et al., 2017; Tobase et al., 2017).

Simulation-based medical education (SBME) is defined as a person, device, or set of conditions that functions to present education and evaluation problems realistically. Different techniques in SBME include high-tech virtual reality simulators, instructed or standardized patients, full-scale mannequins, animals or animal products, human cadavers, or screen-based simulators (Sørensen et al., 2017). Simulation-based learning is said to be the way to "develop health professionals' knowledge, skills, and attitudes, whilst protecting patients from unnecessary risks" (Lateef, 2010, p.348). It also acts to increase confidence and competence, improve clinical decision-making skills, and ready the participant for handling real-life situations in the future (Abas & Juma, 2016). Based on this evidence base, SBME is an effective approach for this project, to enable nurses to practice the NIHSS in a safe environment without risking harm to real patients.

Background and Problem Significance

Over 750,000 people in the United States experience a stroke each year–approximately one every 40 seconds. The direct and indirect costs of stroke and heart disease are estimated to total more than $316.6 billion (American Heart Association, 2017). Nursing interventions aimed at improving both assessment and treatment of acute stroke may improve issues we face on the physical, psychological, and financial spectra. Since the NIHSS is used to obtain a baseline measurement of neurologic status and assist in decision-making about treatment, consistent use of this scale will help in the attainment of optimal patient care and outcome goals.

The National Institutes of Health Stroke Scale (NIHSS) is a nationally validated, highly reliable scoring system for use in the stroke population (Goldstein, Bertels & Davis, 1989; (Kwah & Diong, 2014). It was designed by stroke research neurologists to assess and monitor the severity of neurologic deficits in those suffering from acute strokes. The scale consists of 15 elements that reflect level-of-consciousness, sensory, language, vision and motor functions. Since this scale must be utilized with each stroke patient upon arrival to the ED, within 24 hours of admission, and before discharge from the hospital (The Joint Commission, 2017), it is imperative that nurses maintain proficiency in use of the NIHSS.

Despite having been certified, users of the National Institutes of Health Stroke Scale (NIHSS) continue to express a lack of inter-rater reliability and inaccurate patient scoring. Reliability can be defined as an indicator of how free a scale is from random error, whereas accuracy is a measure to determine the closeness of agreement between a true value and a measurement (Pallant, 2016). Due to a lack of research data on the subject, the exact prevalence of this issue cannot be determined. This issue could, however, affect a multitude of patients who present with acute stroke symptoms, leading to inappropriate treatment strategies–particularly in those patients in which rtPA is considered.

Tissue plasminogen activator is currently the only treatment approved by the Food and Drug Administration (FDA) for ischemic or thrombotic stroke. TPA is a naturally occurring protein found on endothelial cells and is responsible for the conversion of plasminogen to plasmin, an enzyme responsible for clot breakdown. It works by inhibiting the enlargement of blood clots that obstruct blood flow to brain tissue (Vega, 2017). At up to 4.5 hours, treatment with IV rtPA in appropriate patients has been associated with a 28% decrease in mortality at 5 years and a 37% decrease in mortality at 10 years. Those patients who were treated earlier (within the 0-3-hour window) experienced even better results: a 32% mortality reduction at 5 years and 42% at 10 years (Attenhofer, 2018).

Inaccurate NIHSS scoring leading to inappropriate treatment strategies (such as not giving rtPA) can increase hospital costs due to factors such as increased hospital stays and longer need for rehabilitation. The cost of acute stroke is already an issue for our nation, as the U.S. spends approximately $34 billion annually; this includes the cost of medicines to treat stroke, cost of health care services, and missed work days. When it comes to mortality, stroke kills about 140,000 Americans each year, approximating to one death every four minutes (Centers for Disease Control and Prevention, 2017).

A simulation-based educational NIHSS workshop has the potential to improve both accuracy and inter-rater reliability in those who utilize the scale. This workshop is an educational experience that provides nurses with both NIHSS practice in a simulated environment and best-practice advice with rationales. Since the best method of learning the scale is still widely debated, I am proposing a combination of simulated scenarios with debriefing. Evidence has shown that immediately after simulation training, nurses have reported increased confidence upon NIHSS administration (Aebersold, Kocan, Tschannen, & Michaels, 2011; Aebersold & Tschannen, 2013; Garside, Rudd, & Price, 2012; Gill et al., 2016) and an improvement in their communication and leadership skills (Aebersold & Tschannen, 2013; Roots, Thoman, Jaye, &

Birns, 2011). Additionally, three studies demonstrated an increase in cognitive assessment of the patient presenting with acute stroke (Gill et al., 2016; McDavid, Bellamy, & Thompson, 2015; see Table 4). Each of these is a fundamental element of clinical nursing practice with respect to acute stroke management. The potential effect of the simulation-based educational NIHSS workshop is for nurses to continuously produce accurate and reliable NIHSS scores when assessing the acute stroke patient–this may lead to improved patient outcomes as a result of appropriate treatment and a reduction in cost of care due to decreased length of stay.

For healthcare professionals to become NIHSS certified, they must go to a website sponsored by the American Stroke Association or the National Institute of Health and complete a four-hour video certification program. This program has been associated with increased inter-rater reliability following training and subsequent certification; however, research has shown that with limited use in certain practice areas and as the passage of time increases from initial certification, the accuracy of NIHSS scoring decreases (the aforementioned drift effect).

The issue of whether or not the current online training program is the best method of training for the NIHSS is widely debated (Chiu et al., 2009; Hinkle, 2014). Additionally, since the dynamic of the nursing workforce is constantly changing, researchers are examining the optimal teaching method for millennial learners. One study determined that millennials preferred simulation training, and that repeated simulation gave students the opportunity to right what was wrong. Moreover, debriefing in the form of one-on-one constructive criticism offered guidance (Eriam, Smythe, & Wright, 2016). Simulation-based learning is said to be the way to "develop health professionals' knowledge, skills, and attitudes, whilst protecting patients from unnecessary risks" (Lateef, 2010). This way, nurses will be able to practice the NIHSS without risking harm to a patient.

It is important to implement a simulation-based educational NIHSS workshop in the nursing population, since the current required education for the NIHSS has resulted in decreased accuracy and inter-rater reliability over time. Upon reviewing recent literature, it can be determined that implementing a simulation-based educational NIHSS workshop has the potential to have a positive impact on both accuracy and inter-rater reliability of those who utilize the scale. In turn, this has the potential to impact morbidity and mortality rates for this population.

Evidence-Based Practice Model

The evidence-based practice (EBP) model utilized in this project is the Stetler model of research utilization (see Figure 2). Stetler defines this model as a series of critical thinking steps designed to buffer the potential barriers to effective use of research findings (Stetler, 2001). Since its original development in 1976, concepts within the model have been fully integrated to facilitate EBP. This model is comprised of five phases used to organize a research utilization project: 1) preparation, 2) validation, 3) comparative evaluation/decision making, 4) translation/application, and 5) evaluation.

This model functions primarily by assisting practitioners in assessing the relevance of evidence in their findings that can be applied to practice. It is based on the following six assumptions: 1) The formal organization may or may not be involved in an individual's use of research, 2) utilization may be instrumental, conceptual, and/or symbolic, 3) other types of evidence and/or non-research-related information are likely to be combined with research findings to facilitate decision-making or problem-solving, 4) internal and external factors can influence an individual's or group's view and use of evidence, 5) research and evaluation provide us with probabilistic information, not absolutes, and 6) lack of knowledge and skills pertaining to research utilization and EBP can inhibit appropriate and effective use (Stetler, 2001).

Each phase of the Stetler model aids the practitioner in organizing literature to answer a research question (Stetler, 2001). In the preparation phase for this study, the PICOT format was utilized in order to identify a specific question for the literature review. The PICOT format acts by clarifying the population, intervention, comparison, outcome, and the time frame for evaluation (Melnyk & Fineout-Overholt, 2011). Phase two, or validation, includes critiquing the evidence with utilization in mind. This was completed through an extensive literature review based on the PICOT question. Evidence was then assessed based on its validity and reliability in order to implement the most appropriate evidence into this educational program.

Phase three of Stetler's model is comparative evaluation/decision making. During the literature review process, it is essential to synthesize findings from all sources in order to highlight similarities and differences (see Table 4). During this phase, it is also crucial to determine whether the research is desirable or feasible to apply to practice. At this point it was determined that a simulation-based NIHSS education workshop was feasible to implement into practice, as well as desirable (several nurses had expressed an interest in the workshop).

Phase four is translation/application of the practice change. For this project, phase four involved determining the type, exact methods, and potential use of the educational program. The NIHSS simulation education workshop was then implemented in the unit. The final phase of Stetler's model is evaluation. It is in this phase that the outcomes of the practice change were observed and then analyzed appropriately using statistical analysis. The educational program was then evaluated to determine if the overall project goal and objectives were achieved. Implications for future practice and study recommendations were also generated based on findings discovered during the literature review process and the project itself.

Project Methods

Human Subject and Research Approval Procedures:

Following the creation of a project proposal, approval was obtained from the Baptist Health Lexington Nursing and Allied Health Research Office and a letter of support was obtained from Baptist Health Lexington's CNO/COO. An expedited proposal was then submitted and successively approved by the hospital's Institutional Review Board (IRB). A waiver of documentation of informed consent was approved in compliance with IRB regulations, and implied consent forms in the form of a demographic survey were created that conformed to Baptist Health Lexington IRB. Approval also was obtained from the director of the neurological/neurosurgical unit. Potential participants were informed of the project via hospital email communication and paper flyers were placed around the unit.

Study Setting:

This study was conducted in the 19-bed Neurological/Neurosurgical Intensive Care Unit (ICU) at Baptist Health, a comprehensive stroke center located in Lexington, KY. Baptist Health Lexington is a 391-bed tertiary care facility that primarily serves people living in Central Kentucky and surrounding counties.

Study Design:

This study followed a quasi-experimental design since it estimated the causal impact of an intervention on the target population without random assignment. A simulation-based educational NIHSS workshop took place in the Neurological/Neurosurgical unit at Baptist

Health Lexington in order to determine its effect on nursing NIHSS accuracy and inter-rater reliability.

Sample and Selection of Participants:

Inclusion criteria for this study were: a) nurses who are NIHSS certified and b) at least three months have passed since NIHSS certification. Exclusion criteria were: a) nurses who are not NIHSS certified and b) nurses who are NIHSS certified but obtained certification within the past three months. The sampling strategy for this study was based on both systematic and convenient sampling methods. Systematic sampling was utilized since population members were similar to one another on one distinct variable – NIHSS certification. Convenience sampling was used due to the small population size in the unit. The sample size included twenty-six nurses working in the Neurological/Neurosurgical unit at Baptist Health Lexington.

Scenario Development:

With the assistance of a neurological APRN, two distinct scenarios were developed for the purpose of this study. The first scenario involved a 62-year-old female with past medical history significant for hyperlipidemia and hypertension who presented with sudden onset of right-sided weakness and speech difficulty. A computed tomography (CT) scan of the head showed equivocal hypodensity in the left middle cerebral artery (MCA) territory. CT angiography revealed a left MCA occlusion. This was therefore a large-vessel stroke, a type often seen in the neurological/neurosurgical unit at Baptist Health Lexington.

The second scenario involved a 65-year-old male with a past medical history significant for hypertension, coronary artery disease (requiring stenting five years ago), and tobacco abuse, who presented to the ED with dizziness and vision changes. A head CT revealed no early ischemic changes. A CTA was then performed, which showed an acute posterior cerebral artery

(PCA) occlusion. This scenario is one not seen as often in the neurological/neurosurgical unit at Baptist Health Lexington; it was selected to give nurses a chance to practice grading items pertinent to posterior circulation strokes, such as Best Gaze (item 2), Best Visual (item 3) and Limb Ataxia (item 7).

After developing the scenario backgrounds with the neurological APRN, we went through each item and she decided what deficits and item scores would best represent the type of stroke that the patient was experiencing. This particular APRN had previously worked in the neurological/neurosurgical unit at Baptist Health Lexington as a bedside nurse before becoming an advanced practice provider, then going on to work as the stroke coordinator for the hospital (see Figure 3). She works closely with neurologists to determine alteplase eligibility upon patient arrival to the hospital (by conducting her own NIHSS), contacts the neuro-interventionalist and cath lab if it is a large-vessel occlusion requiring a thrombectomy, and is instrumental in correcting deficiencies related to stroke care and coordinating performance improvement in the hospital. She is an expert in her field, making her more qualified to determine correct NIHSS scores for the two scenarios.

Debriefing Framework:

The primary investigator utilized the G.A.S. (gather, analyze, summarize) framework for debriefing (Levine, DeMaria, Schwartz, & Sim, 2013) upon completion of the scenario. This framework focuses on maintaining a student-centered, safe environment where gaps in skill, knowledge, or performance are identified and addressed. In the gather phase, the debriefer actively listened to participants in order to comprehend what they thought and how they felt about how the scenario went. During the analyze phase, the debriefer provided feedback on performance using the taped video for review, reporting observations (correct vs. incorrect) and facilitating participant reflection on their actions. In the summarize phase, the participant and debriefer together summarized the session, identified positive aspects of the scenario, and discussed behaviors to change for future practice (Levine, DeMaria, Schwartz, & Sim, 2013).

Instruments:

The NIHSS (see figure 1) is a 15-item scale utilized to measure the severity of a stroke. It was originally developed in 1989, and is now currently the gold-standard for assessing stroke-related deficits and for measuring outcomes related to treatment (Kwah & Diong, 2014). The NIHSS incorporates the following domains: level of consciousness, ocular movement, visual field integrity, facial movement, arm and leg muscle strength, sensation, coordination, speech, language, and neglect. The NIHSS is reported to have moderate-to-high reliability when used by medical and non-medical staff (intra-rater $\kappa = 0.66$ to 0.77; inter-rater $\kappa = 0.69$). Exceptionally high reliability has also been demonstrated when clinicians rate from patient videos (intra-rater ICC = 0.93; inter-rater ICC = 0.95; Kwah & Diong, 2014).

Procedures:

The study was presented to potential participants in a staff meeting by the primary investigator at Baptist Health Lexington two weeks prior to the first workshop. Participants took this time to discuss the study/ask questions as needed. Those who were unable to attend the meeting received an email for recruitment, and flyers were placed around the unit with workshop dates as well. The majority of consents were completed and returned on the day the study was presented. The rest were obtained prior to the workshop date upon which the individual participated.

Upon gaining consent, participants demonstrated the NIHSS on a patient (actor) who acted out a stroke scenario with specific deficits (these sessions were videotaped). The actor was a volunteer who is also a nurse on the unit–she was trained on key learning objectives, the case history (physical symptoms, organized whole of the character, interaction guidelines), and a dry run of the scenario was also completed beforehand. The scenario took place in an empty patient room on the unit to make it more realistic. A neurological APRN previously scored the patient and acted as the “expert opinion” for accuracy of scoring. Following the simulation session, video-assisted debriefing (VAD) using the GAS model took place in order to discuss the results of each individual NIHSS item score, utilizing the taped video for review and discussion purposes. Best practice examples of how to correctly perform the NIHSS were also demonstrated at this time. The participants then demonstrated the NIHSS on the actor in a second scenario in order to evaluate the effect of the simulation. Data were obtained from nursing providers on each shift and therefore required four simulation-based NIHSS workshops in order to reach all participants. All observed and recorded data were kept on a password-encrypted computer.

Study Goal and Objectives

Study Goal: The overall study goal was to examine the effect of a simulation-based educational workshop on nurses’ accuracy in using the instrument, as well as on the inter-rater reliability of the NIHSS tool.

Outcome Measure #1: The first main outcome of this study was to determine the effect of the simulation-based educational workshop on inter-rater reliability among nurses utilizing the NIHSS tool. Inter-rater reliability is generally defined as the degree of agreement among raters. In this study it will be defined as the degree of agreement among raters utilizing the NIHSS.

Data Analysis: Frequency distributions including standard deviations were used in order to evaluate the comparisons of all variables within the NIHSS and total scores to determine inter-rater reliability. Statistical analysis was performed using IBM SPSS software, version 25.

Outcome Measure #2: The second outcome of this study was to determine the effect of the simulation-based educational workshop on nurses' accuracy in regard to overall scoring on the NIHSS. Accuracy is defined as the quality or state of being correct or precise. In this study it was defined as the correctness of NIHSS scoring as compared to the expert user's scores.

Data Analysis: Frequency distributions were again utilized to look at total scores pre- and post-intervention to determine accuracy. Additionally, Fisher's Exact Test was conducted (since assumptions for Chi-square analysis were not met) to determine if the difference in pre- and post-scores was statistically significant. Statistical analysis was performed using IBM SPSS software, version 25.

Results

A total of 26 nurses participated in the study. Three additional nurses expressed interest in participating, but were excluded from the study due to NIHSS recertification within the past three months from the time the study was conducted. The majority of participants (57.7%) ranged in age from 26-35 years old; 19.2% fell within the age group of 18-25, and another 19.2% were in the 36-45 age group. Only one nurse (3.8%) was in the age group for 46-55. The majority of nurses possessed at least a BSN degree or lower (96.2%), and one nurse had their MSN or higher (3.8%; see Table 1).

When looking at inter-rater agreement among each individual item of the NIHSS, five of the fifteen items revealed interesting results. These included: item 3, Best Visual; item 4, Facial Palsy; item 7, Limb Ataxia, item 8, Sensory; and item 11, Extinction and Inattention (formerly neglect). On item 3 (Best Visual), in scenario one only 10 participants (38.5%) scored correctly. In scenario two, 19 participants (73.1%) scored correctly (SD=0.56 and 0.45, respectively). On item 4 (Facial Palsy), in scenario one 17 (65.4%) participants scored correctly, whereas in scenario two all participants scored correctly (SD=0.75 and 0, respectively). On item 7 (Limb Ataxia), in scenario one 23 (88.5%) participants scored correctly, whereas in scenario two 25 (96.2%) participants scored correctly (SD=0.32 and 0.19, respectively). This item in particular was not statistically significant, but was of interest since ataxia was untestable in scenario one, and therefore the correct score was presumed to be higher. On item 8 (Sensory), in scenario one 16 (61.5%) participants scored correctly, and in scenario two all participants scored correctly (SD=0.49 and 0, respectively). Lastly, on item 11 (Extinction and Inattention), in scenario one 16 (61.5%) participants scored correctly and in scenario two 22 (84.6%) participants scored correctly (SD=0.49 and 0.36, respectively).

Upon looking at total scores for scenario one, scores ranged from 19-25 (correct score was 23). Only four (15.4%) of participants scored the patient correctly in this scenario (see Table 2). In the second scenario, total scores ranged from 7-9 (correct score was 8). Nineteen participants (73.1%) scored the patient correctly in this scenario (see Table 3). Although the difference in accuracy of total scores was clinically highly significant, the results were not deemed statistically significant ($P=.287$, Fisher's Exact Test). However, variability of scores did improve from scenario one to scenario two (SD=1.74 and 0.53, respectively).

Discussion

In this study utilizing simulation training to increase accuracy and inter-rater reliability among nurses using the NIHSS, both accuracy of total scores and inter-rater agreement with respect to five scale items increased post-intervention. When comparing project data to various studies in the literature, some interesting similarities emerge. In regard to NIHSS overall scoring after scenario one was completed, there were discrepancies in 84.6% of cases. In a study by Wolfe and Kelly (2017) comparing emergency medicine (EM) and neurology residents' NIHSS scores on live patients, discrepancies were found in 72% of cases. The same study also revealed scoring inconsistencies with scale items such as limb ataxia (p=0.023) and extinction and inattention (p=0.046), which also proved inconsistent after scenario one in the project data as well (SD=0.32 and 0.49, respectively).

Specific items on the scale which subjects found most difficult to score included item 3, Best Visual; item 4, Facial Palsy; item 7, Limb Ataxia, item 8, Sensory; and item 11, Extinction and Inattention (formerly neglect). In item 3, best visual, the mistake several participants made was that upon testing visual threat they only introduced a striking hand threat into two of the patient’s visual fields. To appropriately assess visual threat a striking hand threat must be performed in all four of the patient’s visual fields. For item 4, facial palsy, in scenario one the patient did not follow commands (typically the examiner would ask the patient to smile or raise eyebrows); therefore, in order to correctly assess facial palsy a painful stimulus should be applied, and the patient’s grimace should be evaluated (several participants failed to elicit a painful stimulus). In item 7, limb ataxia, the patient could not understand the command in scenario one and therefore ataxia should have been scored as absent. Many participants gave the patient a score of 1 or 2 in this category due to extremity weakness, which was incorrect. In item 8, sensory, several participants scored the patient a 2 for severe or total sensory loss; the correct score was 1, which was mild to moderate sensory loss. Upon reading into the scale, it states that a score of 2 is only given if the patient is unaware of noxious stimuli – if the examiner were to apply painful stimulus to the right extremities the patient would have grimaced (and therefore was aware of being touched). Lastly in item 11, extinction and inattention, the examiner is required to add up the patient’s various deficits (visual, auditory, tactile, spatial, or personal) upon performing bilateral simultaneous stimulation. In scenario one, several participants incorrectly scored the patient a 1 (tactile inattention) when they should have been scored a 2 (tactile and visual inattention).

This study utilized a live actor to portray the stroke patient, which is a key advantage for teaching the NIHSS. A video and/or mannequin used for simulation training would not be able to mimic specific neurological deficits as well as a trained actor. Additionally, the use of a patient actor and an empty room on the unit allowed for the scenario to be as real as possible. One negative point is that the same actor was used for both scenarios–in the future a different actor should be used for each scenario in order to eliminate any confusion for the rater.

During the video-assisted debriefing sessions, each participant received feedback on his or her performance, as an incentive to improve their skill set. A majority of participating nurses provided oral feedback that simulation workshops should be conducted more frequently and that new orientees should participate in the workshop before caring for a real patient with a stroke. A number of nurses expressed that it was beneficial to assess a “patient” experiencing a type of stroke that is not cared for as frequently in the unit (as in scenario two).

The research conducted in this study is subject to several limitations. The first limitation is a small sample size due to lack of eligible participants; this complicated statistical measurement and underpowered study results. It was also the reason that convenience sampling was used instead of randomized sampling. The second limitation is sample bias. Selection was not random as participants were nurses who work in the same unit as the primary investigator. Another limitation is that this was a single-center study. The unit in which this study was conducted is where the majority of patients with a stroke are cared for, thus the largest effect from the study would have been seen. The last limitation is that there was only one person serving as the expert opinion for NIHSS scoring – in the future I would have included a panel of experts.

Implications for Clinical Practice

With the wealth of information gained through this project and the literature review conducted beforehand, a few implications can be addressed for clinical practice. Advanced practice providers need educated bedside RNs who can quickly and accurately assess those presenting with acute stroke so that the proper treatment intervention can be implemented in a timely manner. Simulation has shown to improve both accuracy and inter-rater reliability in users of the NIHSS. Furthermore, simulations are performed without putting a real patient with a stroke at risk. Data from this study indicate that there is a need for routine unit-specific NIHSS education in order to prevent a “drift effect.” How routine? A decrease in inter-rater reliability has been shown to occur within three months of NIHSS certification (Goldstein & Samsa, 2001; O’Farrel & Zou, 2008; Schmulling, Grond, Rudolf, & Kiencke, 1998).

Additionally, in light of the data collected during this study, the NIHSS simulation workshop can act as a learning assessment to determine a unit’s strengths and weaknesses in regard to certain items on the NIHSS. For example, if a second NIHSS simulation workshop were conducted at the same facility in three months from the date of this study, I would concentrate on more training/simulation opportunities that included the five items with which the majority of participants seemed to struggle. Determining staff weaknesses and providing repeated NIHSS education in a simulated environment would further improve accuracy and inter-rater reliability.

Future Study Recommendations

Literature regarding NIHSS education has not been rigorously evaluated for its impact on patient care outcomes. Therefore, I recommend more research examining the association between NIHSS education and patient outcomes post appropriate treatment for acute stroke. Another study recommendation would be to determine if there is any difference in learning outcomes when comparing simulation to other educational approaches. Since the dynamic of the nursing workforce is constantly changing, it would be beneficial to determine the optimal teaching method for all learners of the scale.

Conclusion

The goal of this study was to examine the effect of a simulation-based educational NIHSS workshop on nursing accuracy and inter-rater reliability upon use of the tool. The workshop was shown to increase both accuracy and inter-rater reliability of scoring, although some results were not statistically significant. In light of this a definitive practice change is not necessary; however, NIHSS education involving the use of simulation should be performed at regular intervals (about every three months) to maintain accuracy and inter-rater reliability and prevent a drift effect. Additional research is warranted to determine if there is a correlation between NIHSS education and patient outcomes, and to determine if simulation training is the best approach to educate the current nursing population.

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Table 1. *Sample demographics (N=26)*

Category	N (%)
Age	
• 18-25	5 (19.2%)
• 26-35	15 (57.7%)
• 36-45	5 (19.2%)
• 46-55	1 (3.8%)
Education Level	
• BSN or lower	25 (96.2%)
• MSN or higher	1 (3.8%)

Table 2. *Total scores scenario 1 (SD=1.74)*

Score	Frequency (N=26)	Percent (%)
19	2	7.7%
20	7	26.9%
21	4	15.4%
22	4	15.4%
23*	4	15.4%
24	4	15.4%
25	1	3.8%

*Correct score

Table 3. *Total scores scenario 2 (SD=0.53)*

Score	Frequency (N=26)	Percent (%)
7	4	15.4%
8*	19	88.5%
9	3	11.5%

*Correct score

Table 4. *Summary of reviewed articles*

Author (s), Date of Publication & Title	Study Design	Sample/Setting	Major Variables Studied and their Definitions	Measurement of Major Variables	Findings
Aebersold, M., Kocan, M.J., Tschannen, D., & Michaels, J. (2011). Use of simulation in stroke unit education. Journal of Neuroscience Nursing, 43(6), 349-353.	Descriptive study. Respondents completed acute stroke training involving classroom discussion and simulation training with feedback.	35 nurses on orientation to a new stroke unit at a large academic medical center in the Midwest.	No variables. Purpose was to describe an innovative simulation education plan implemented to train stroke unit nurses.	3-point Likert scale. Respondents were also asked to identify “how they would change their practice as a result of participating in the educational activity” and if they had any suggestions for improvement in the training.	All 32 participants (100%) rated the simulation training as excellent. One participant stated, “Thanks for the hands-on with the monitors! The SimLab was really interesting, especially to recreate scenarios that have happened.” Another nurse stated, “I can now take stroke patients (in the stroke unit) and feel at least capable of going into the room…it gave me a chance to see stroke patients in a different more critical aspect.”

Aebersold, M., Tschannen, D., (May 31, 2013) "Simulation in Nursing Practice: The Impact on Patient Care" OJIN: The Online Journal of Issues in Nursing Vol. 18, No. 2, Manuscript 6.	Literature Review. This article is not a comprehensive review of the literature on simulation or its impact of simulation on patient outcomes, but rather considers selected publications to direct readers to budding evidence and provide some context for later discussion about simulation in nursing practice.	Review of 38 selected publications.	No variables. The purpose of this article is to provide an overview of simulation techniques and uses and to review selected simulation research.	N/A	In one publication related to stroke, pre and post questionnaires showed a self-reported improvement in leadership, communication skills, and confidence in managing hyper-acute stroke clinical situations in six of seven respondents. In another publication related to stroke, overall evaluation by nursing staff after the simulation and debriefing was very positive; 100% of the participants ranked the effectiveness of the simulations as excellent.
Chiu, S.-C., Cheng, K.-Y., Sun, T.-K., Chang, K.-C., Tan, T.-Y., Lin, T.-K., … Yeh, S.-H. (2009). The effectiveness of interactive computer assisted instruction compared to videotaped instruction for teaching nurses to assess neurological function of stroke patients: A randomized controlled	RCT. Nurses were randomly placed in either the ICAI or the IVLP group in order to learn the Chinese version of the National Institute of Health Stroke Scale (C-NIHSS). Nursing satisfaction upon use of the teaching programs was assessed by one pretest and two post-tests.	There were 44 participating nurses in the ICAI group and 40 participating nurses in the IVLP group. The setting included six neurology and neurosurgery wards at two hospitals in southern Taiwan.	The independent variable is whether the participating nurse was assigned to the C-NIHSS interactive computer assisted instruction (ICAI) group or the instructor-led videotape learning program (IVLP group. The dependent variable was the level of learner satisfaction.	The measurement tools included in this experiment were the score verification unit (SVU) (score range from 0 to 45, content validity index, CVI = 0.96, percentage agreement = 84%) and the learner satisfaction scale (CVI = 0.92, Cronbach's alpha = 0.97).	Results showed that in the second post-test, the ICAI group's score was significantly higher than that of the IVLP group ($F=4.81$, $p=0.03$). There was a positive correlation between correctness of assessment on the second post-test and length of experience in neurological nursing ($r=0.35$, $p<0.05$). This concludes that nurses with less experience in neurological

trial. *International Journal of Nursing Studies*, *46*(12), 1548–1556. doi:10.1016/j.ijnurstu.2009.05.008					nursing who receive ICAI will perform a better assessment of stroke patients than those who received IVLP.
Garside, M. J., Rudd, M. P., & Price, C. I. (2012). Stroke and TIA Assessment training. *Stroke and TIA Assessment Training: A New Simulation-Based Approach to Teaching Acute Stroke Assessment*, *7*(2), 117–122. doi:10.1097/sih.0b013e318233625b	Descriptive study. STAT scanarios were developed utilizing a Laerdal SimMan 3G patient simulator. A facilitator would accompany the learner in the scenario and observe actions. Before and after attendance at a STAT event, participants completed an online multiple-choice question (MCQ) test, comprising 16 questions randomly selected from a bank of 32 that reflects topics during training.	The sample included 779 clinical staff (nurses and junior doctors) in the United Kingdom.	No variables. The purpose of this study was to describe a way in which limitations (lack of current simulator technology with stroke-related focal neurologic assessment) can be overcome to harness the benefits of simulation for stroke education.	At the end of each day of training, participants anonymously completed feedback forms. These utilized a 0 to 10 numerical rating scale (0= “not at all”; 10= “extremely”) to answer questions related to present confidence and perceived usefulness of the simulation training.	Results showed that the median self-confidence in the clinical assessment of stroke patients increased from 4/10 pre-training to 8/10 post-training ($p=<0.01$). Usefulness of the simulator in the training was rated highly, receiving a median score of 9/10.
Gill, R., Rasmussen, T., Garg, R., Ray, J., McCoyd, M., & Ruland, S. (2016). Abstract TP312: Simulation Based Education for Neurology Nurses to Improve In-hospital Stroke Emergency Performance. *Stroke*, *47*(1), . Retrieved from http://stroke.ah	Descriptive study. Eight neuro ICU nurses participated in a high-fidelity patient simulation of an in-hospital ischemic stroke patient eligible for IV tPA. Each nurse independently managed tasks including a focused patient assessment, verifying and evaluative vitals and treating appropriately,	The sample included eight neuro ICU nurses in an in-hospital stroke simulation study.	No variables. The purpose of this study was to test the use of simulation-based medical education (SBME) on stroke emergency performance, particularly in inexperienced stroke team members.	Scales were not used, but nurses completed an affective survey, pre- and post-test cognitive assessment and debriefing with feedback. An evaluator completed a real-time checklist of pre-defined tasks and the subject participated in a review of their performance	Results showed a 19.4% improvement in the cognitive assessment post-simulation ($p=0.02$). The affective survey showed nurses were confident in ability to perform the NIHSS.

ajournals.org/content/47/Suppl_1/ATP312	expediting labs, and coordinating care with the stroke team.			with the stroke team.	
McDavid, J., Bellamy, L., & Thompson, C. (2015). Abstract NS12: Online NIHSS Certification Enough Training. *Stroke*, *46*(1), . Retrieved from http://stroke.ahajournals.org/content/46/Suppl_1/ANS12	Descriptive study. Nurses went through 6 weeks of NIHSS training that involved three phases: 1) completion of online NIHSS certification with additional face-to-face instruction, 2) evaluation of competency in a simulated patient scenario, 3) the third phase was reserved for those nurses who failed the competency evaluation. They were required to receive face-to-face instruction as a remedial measure and repeat the competency evaluation.	The sample included 114 nurses from the ED, ICU, Medical-Surgical, and the Float Pool in a rural hospital pursuing Primary Stroke Center certification.	This study posed the following question: Is online NIHSS enough training?	No scales were utilized. Data analysis was based on a pass/fail of the competency evaluation. All nurses were required to pass the NIHSS certification online.	Face-to-face instruction accompanied by simulation training enhances stroke assessment. Of the 114 nurses that completed the first two phases of training, 36 (32%) failed the competency in phase two. Eight (89%) of nurses that voluntarily completed face-to-face instruction in phase one passed the evaluation in phase two. In the third phase, 36 (100%) of nurses that received remedial face-to-face instruction passed the repeat competency evaluation.
O'Farrell, B., G. Y. Zou. "Implementation of the Canadian Neurological Scale on an Acute Care Neuroscience Unit: A Program Evaluation." *The Journal of Neuroscience Nursing: Journal of the American Association of Neuroscience Nurses.* U.S. National Library of	Descriptive evaluation study. Questionnaires were administered before, immediately after, and three months after the workshop. Following implementation, a patient chart audit was performed to evaluate the appropriateness and accuracy of documentation of the bedside CNS tool.	66 nurses successfully completed the workshop at University Hospital, London Health Sciences Centre.	No variables. This study had two purposes: first was to explore nurses' values and perceptions of BPGs and the CNS assessment and to assess the effect of the workshop and implementation process on self-efficacy while using the CNS assessment. Secondly, they wanted to	The Perception of Best Practice and Neurological Assessment Tool, the Self-Evaluation of Performance of Canadian Neurological Scale Assessment Questionnaire, An Evaluation of Workshop Tool, The Learning Experience Tool, and The Patient Chart Audit Tool	Results showed a significant increase in confidence in overall performance of the CNS assessment from before to immediately after the workshop ($p < .0001$). There was a slight decrease in confidence in overall performance of the CNS assessment from immediately after to 3 months after the workshop ($p = .07$) as well.

Medicine, Aug. 2008. Web. 22 Jan. 2017.			determine whether the workshop and implementation process met nurses' needs and to evaluate the accuracy and appropriateness of CNS assessment documentation.	were utilized in this study.	Overall, 94% of participants agreed or strongly agreed that the workshop met their learning needs.
Roots, A., Thomas, L., Jaye, P., & Birns, J. (2011). Simulation training for hyperacute stroke unit nurses. British Journal Of Nursing, 20(21), 1352-1356.	Quality improvement study. Participants were presented with a number of clinical scenarios directly relevant to the HASU (Hyper acute stroke unit) patient care. Between one and three candidates took part in each scenario and the course was held in a designated simulation suite set up to replicate the accident. Participants interacted with the high-fidelity mannequin (SimMan 3G) whose physiology was controlled remotely as the scenario evolved.	The sample and setting included six nurses and one doctor working on the HASU at St. Thomas' Hospital in London.	No variables. The purpose of this article was to describe the role that simulation training might play for nurses working on hyper acute stroke units (HASU) and to explain the modalities available and educational potential.	Pre- and post-course questionnaires were utilized, containing both quantitative questions based on a Likert scale and open-ended qualitative questions. Participants were also asked to assess their leadership and communication skills as well as their confidence in managing emergency situations using the 'patient at risk' (PAR) score on a scale of one (little or no skill/confidence) to seven (high level of skill/confidence).	Six of the seven candidates' post-course questionnaires showed a self-reported improvement in their leadership, communication skills and confidence in managing hyperacute stroke clinical situations. There was also an increase in the mean score in all non-technical domains. Within qualitative feedback, each candidate expressed that they felt the scenarios were realistic of working life and they enjoyed revisiting uncommon acute scenarios.

Note. BPGs=Best Practice Guidelines; C-NIHSS=Chinese version of the NIHSS; CNS=Canadian Neurological Assessment; CVA=Cerebrovascular Accident; GOS=Glascow Outcome Scale; HASU=Hyper Acute Stroke Unit; ICAI=Interactive Computer Assisted Instruction; IVLP= Instructor Led Videotape Learning Program; NIHSS=National Institutes of Health Stroke Scale; SBME=Simulation Based Medical Education; STAT=Stroke and TIA Assessment Training; SVU=Score Verification Unit; TIA=Transient Ischemic Attack; tPA=Tissue Plasminogen Activator

Figure 1. *NIHSS*

NIH
STROKE
SCALE

Patient Identification. ___ ___-___ ___ ___-___ ___ ___

Pt. Date of Birth ___ ___/___ ___/___ ___

Hospital ______________________(___ ___-___ ___)

Date of Exam ___ ___/___ ___/___ ___

Interval: [ ] Baseline [ ] 2 hours post treatment [ ] 24 hours post onset of symptoms ±20 minutes [ ] 7-10 days
[ ] 3 months [ ] Other ______________________________(___ ___)

Time: ___ ___:___ ___ [ ]am [ ]pm

Person Administering Scale ___________________________________

Administer stroke scale items in the order listed. Record performance in each category after each subscale exam. Do not go back and change scores. Follow directions provided for each exam technique. Scores should reflect what the patient does, not what the clinician thinks the patient can do. The clinician should record answers while administering the exam and work quickly. Except where indicated, the patient should not be coached (i.e., repeated requests to patient to make a special effort).

Instructions	Scale Definition	Score
1a. Level of Consciousness: The investigator must choose a response if a full evaluation is prevented by such obstacles as an endotracheal tube, language barrier, orotracheal trauma/bandages. A 3 is scored only if the patient makes no movement (other than reflexive posturing) in response to noxious stimulation.	0 = **Alert;** keenly responsive. 1 = **Not alert**; but arousable by minor stimulation to obey, answer, or respond. 2 = **Not alert**; requires repeated stimulation to attend, or is obtunded and requires strong or painful stimulation to make movements (not stereotyped). 3 = Responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, and areflexic.	_____
1b. LOC Questions: The patient is asked the month and his/her age. The answer must be correct - there is no partial credit for being close. Aphasic and stuporous patients who do not comprehend the questions will score 2. Patients unable to speak because of endotracheal intubation, orotracheal trauma, severe dysarthria from any cause, language barrier, or any other problem not secondary to aphasia are given a 1. It is important that only the initial answer be graded and that the examiner not "help" the patient with verbal or non-verbal cues.	0 = **Answers** both questions correctly. 1 = **Answers** one question correctly. 2 = **Answers** neither question correctly.	_____
1c. LOC Commands: The patient is asked to open and close the eyes and then to grip and release the non-paretic hand. Substitute another one step command if the hands cannot be used. Credit is given if an unequivocal attempt is made but not completed due to weakness. If the patient does not respond to command, the task should be demonstrated to him or her (pantomime), and the result scored (i.e., follows none, one or two commands). Patients with trauma, amputation, or other physical impediments should be given suitable one-step commands. Only the first attempt is scored.	0 = **Performs** both tasks correctly. 1 = **Performs** one task correctly. 2 = **Performs** neither task correctly.	_____
2. Best Gaze: Only horizontal eye movements will be tested. Voluntary or reflexive (oculocephalic) eye movements will be scored, but caloric testing is not done. If the patient has a conjugate deviation of the eyes that can be overcome by voluntary or reflexive activity, the score will be 1. If a patient has an isolated peripheral nerve paresis (CN III, IV or VI), score a 1. Gaze is testable in all aphasic patients. Patients with ocular trauma, bandages, pre-existing blindness, or other disorder of visual acuity or fields should be tested with reflexive movements, and a choice made by the investigator. Establishing eye contact and then moving about the patient from side to side will occasionally clarify the presence of a partial gaze palsy.	0 = **Normal.** 1 = **Partial gaze palsy;** gaze is abnormal in one or both eyes, but forced deviation or total gaze paresis is not present. 2 = **Forced deviation,** or total gaze paresis not overcome by the oculocephalic maneuver.	_____

Rev 10/1/2003

N I H
STROKE
SCALE

Patient Identification. ______ - ______ - ______

Pt. Date of Birth ____ / ____ / ____

Hospital ____________________ (____ - ____)

Date of Exam ____ / ____ / ____

Interval: [] Baseline [ ] 2 hours post treatment [ ] 24 hours post onset of symptoms ±20 minutes [ ] 7-10 days
[ ] 3 months [ ] Other ______________________ (______)

3. Visual: Visual fields (upper and lower quadrants) are tested by confrontation, using finger counting or visual threat, as appropriate. Patients may be encouraged, but if they look at the side of the moving fingers appropriately, this can be scored as normal. If there is unilateral blindness or enucleation, visual fields in the remaining eye are scored. Score 1 only if a clear-cut asymmetry, including quadrantanopia, is found. If patient is blind from any cause, score 3. Double simultaneous stimulation is performed at this point. If there is extinction, patient receives a 1, and the results are used to respond to item 11.	0 = **No visual loss.** 1 = **Partial hemianopia.** 2 = **Complete hemianopia.** 3 = **Bilateral hemianopia** (blind including cortical blindness).	____
4. Facial Palsy: Ask – or use pantomime to encourage – the patient to show teeth or raise eyebrows and close eyes. Score symmetry of grimace in response to noxious stimuli in the poorly responsive or non-comprehending patient. If facial trauma/bandages, orotracheal tube, tape or other physical barriers obscure the face, these should be removed to the extent possible.	0 = **Normal** symmetrical movements. 1 = **Minor paralysis** (flattened nasolabial fold, asymmetry on smiling). 2 = **Partial paralysis** (total or near-total paralysis of lower face). 3 = **Complete paralysis** of one or both sides (absence of facial movement in the upper and lower face).	____
5. Motor Arm: The limb is placed in the appropriate position: extend the arms (palms down) 90 degrees (if sitting) or 45 degrees (if supine). Drift is scored if the arm falls before 10 seconds. The aphasic patient is encouraged using urgency in the voice and pantomime, but not noxious stimulation. Each limb is tested in turn, beginning with the non-paretic arm. Only in the case of amputation or joint fusion at the shoulder, the examiner should record the score as untestable (UN), and clearly write the explanation for this choice.	0 = **No drift;** limb holds 90 (or 45) degrees for full 10 seconds. 1 = **Drift;** limb holds 90 (or 45) degrees, but drifts down before full 10 seconds; does not hit bed or other support. 2 = **Some effort against gravity;** limb cannot get to or maintain (if cued) 90 (or 45) degrees, drifts down to bed, but has some effort against gravity. 3 = **No effort against gravity;** limb falls. 4 = **No movement.** UN = **Amputation** or joint fusion, explain: ____________ **5a. Left Arm** **5b. Right Arm**	____ ____
6. Motor Leg: The limb is placed in the appropriate position: hold the leg at 30 degrees (always tested supine). Drift is scored if the leg falls before 5 seconds. The aphasic patient is encouraged using urgency in the voice and pantomime, but not noxious stimulation. Each limb is tested in turn, beginning with the non-paretic leg. Only in the case of amputation or joint fusion at the hip, the examiner should record the score as untestable (UN), and clearly write the explanation for this choice.	0 = **No drift;** leg holds 30-degree position for full 5 seconds. 1 = **Drift;** leg falls by the end of the 5-second period but does not hit bed. 2 = **Some effort against gravity;** leg falls to bed by 5 seconds, but has some effort against gravity. 3 = **No effort against gravity;** leg falls to bed immediately. 4 = **No movement.** UN = **Amputation** or joint fusion, explain: ____________ **6a. Left Leg** **6b. Right Leg**	____

Rev 10/1/2003

N I H
STROKE
SCALE

Patient Identification._______-_______-_______

Pt. Date of Birth______/______/______

Hospital____________________(____-____)

Date of Exam______/______/______

Interval: [] Baseline [ ] 2 hours post treatment [ ] 24 hours post onset of symptoms ±20 minutes [ ] 7-10 days
[ ] 3 months [ ] Other______________________________(______)

7. Limb Ataxia: This item is aimed at finding evidence of a unilateral cerebellar lesion. Test with eyes open. In case of visual defect, ensure testing is done in intact visual field. The finger-nose-finger and heel-shin tests are performed on both sides, and ataxia is scored only if present out of proportion to weakness. Ataxia is absent in the patient who cannot understand or is paralyzed. Only in the case of amputation or joint fusion, the examiner should record the score as untestable (UN), and clearly write the explanation for this choice. In case of blindness, test by having the patient touch nose from extended arm position.	0 = **Absent.** 1 = **Present in one limb.** 2 = **Present in two limbs.** UN = **Amputation** or joint fusion, explain: ____________	____
8. Sensory: Sensation or grimace to pinprick when tested, or withdrawal from noxious stimulus in the obtunded or aphasic patient. Only sensory loss attributed to stroke is scored as abnormal and the examiner should test as many body areas (arms [not hands], legs, trunk, face) as needed to accurately check for hemisensory loss. A score of 2, "severe or total sensory loss," should only be given when a severe or total loss of sensation can be clearly demonstrated. Stuporous and aphasic patients will, therefore, probably score 1 or 0. The patient with brainstem stroke who has bilateral loss of sensation is scored 2. If the patient does not respond and is quadriplegic, score 2. Patients in a coma (item 1a=3) are automatically given a 2 on this item.	0 = **Normal;** no sensory loss. 1 = **Mild-to-moderate sensory loss;** patient feels pinprick is less sharp or is dull on the affected side; or there is a loss of superficial pain with pinprick, but patient is aware of being touched. 2 = **Severe to total sensory loss;** patient is not aware of being touched in the face, arm, and leg.	____
9. Best Language: A great deal of information about comprehension will be obtained during the preceding sections of the examination. For this scale item, the patient is asked to describe what is happening in the attached picture, to name the items on the attached naming sheet and to read from the attached list of sentences. Comprehension is judged from responses here, as well as to all of the commands in the preceding general neurological exam. If visual loss interferes with the tests, ask the patient to identify objects placed in the hand, repeat, and produce speech. The intubated patient should be asked to write. The patient in a coma (item 1a=3) will automatically score 3 on this item. The examiner must choose a score for the patient with stupor or limited cooperation, but a score of 3 should be used only if the patient is mute and follows no one-step commands.	0 = **No aphasia;** normal. 1 = **Mild-to-moderate aphasia;** some obvious loss of fluency or facility of comprehension, without significant limitation on ideas expressed or form of expression. Reduction of speech and/or comprehension, however, makes conversation about provided materials difficult or impossible. For example, in conversation about provided materials, examiner can identify picture or naming card content from patient's response. 2 = **Severe aphasia;** all communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. Range of information that can be exchanged is limited; listener carries burden of communication. Examiner cannot identify materials provided from patient response. 3 = **Mute, global aphasia;** no usable speech or auditory comprehension.	____
10. Dysarthria: If patient is thought to be normal, an adequate sample of speech must be obtained by asking patient to read or repeat words from the attached list. If the patient has severe aphasia, the clarity of articulation of spontaneous speech can be rated. Only if the patient is intubated or has other physical barriers to producing speech, the examiner should record the score as untestable (UN), and clearly write an explanation for this choice. Do not tell the patient why he or she is being tested.	0 = **Normal.** 1 = **Mild-to-moderate dysarthria;** patient slurs at least some words and, at worst, can be understood with some difficulty. 2 = **Severe dysarthria;** patient's speech is so slurred as to be unintelligible in the absence of or out of proportion to any dysphasia, or is mute/anarthric. UN = **Intubated** or other physical barrier, explain:________________	____

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NIH
STROKE
SCALE

Patient Identification._______ - _______ - _______

Pt. Date of Birth______ / ______ / ______

Hospital____________________ (_____ - _____)

Date of Exam______ / ______ / ______

Interval: [] Baseline [ ] 2 hours post treatment [ ] 24 hours post onset of symptoms ±20 minutes [ ] 7-10 days
[ ] 3 months [ ] Other____________________________(______)

11. Extinction and Inattention (formerly Neglect): Sufficient information to identify neglect may be obtained during the prior testing. If the patient has a severe visual loss preventing visual double simultaneous stimulation, and the cutaneous stimuli are normal, the score is normal. If the patient has aphasia but does appear to attend to both sides, the score is normal. The presence of visual spatial neglect or anosagnosia may also be taken as evidence of abnormality. Since the abnormality is scored only if present, the item is never untestable.	0 = **No abnormality.** 1 = **Visual, tactile, auditory, spatial, or personal inattention** or extinction to bilateral simultaneous stimulation in one of the sensory modalities. 2 = **Profound hemi-inattention or extinction to more than one modality;** does not recognize own hand or orients to only one side of space.	____

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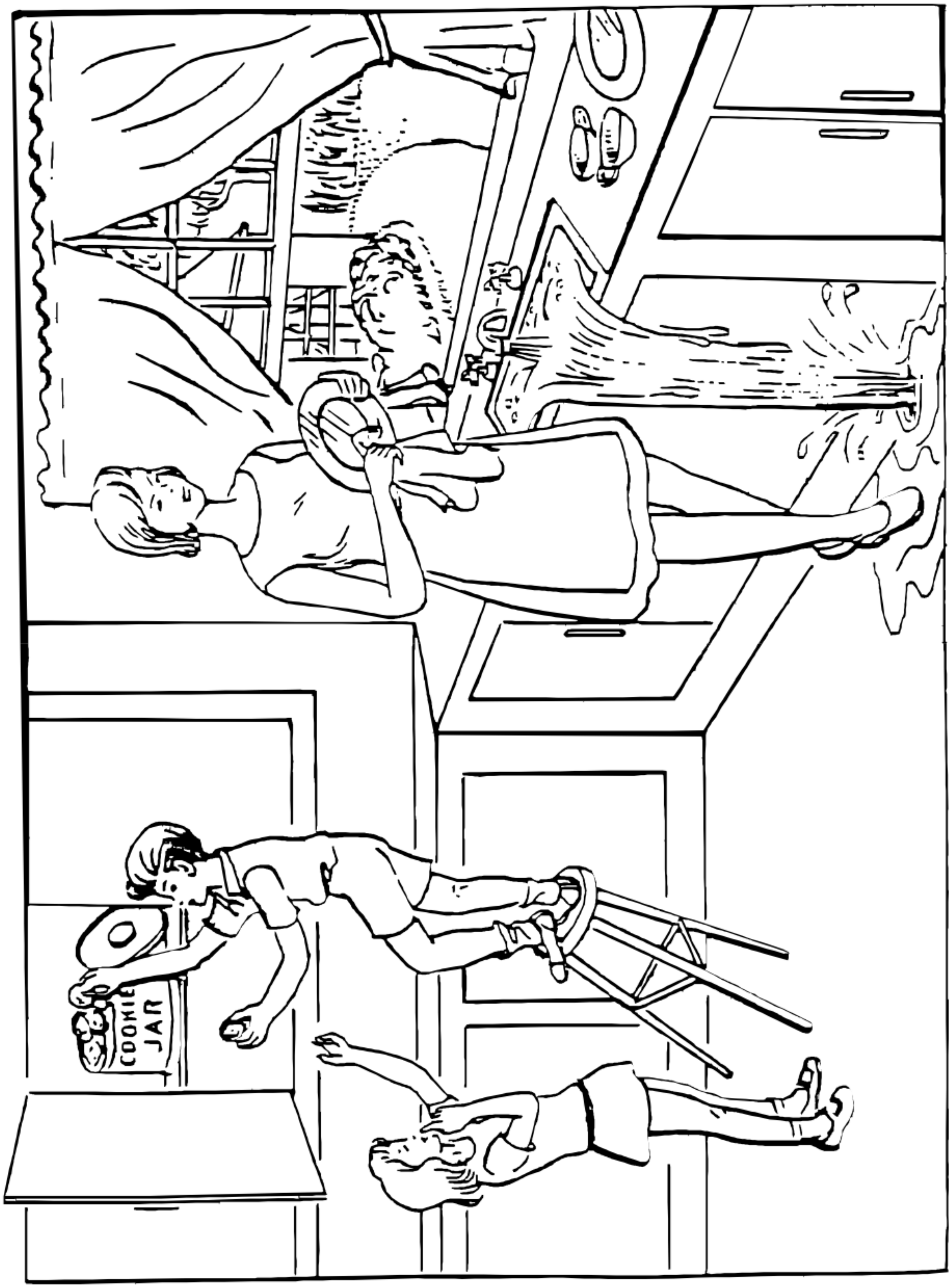
COOKIE
JAR

You know how.

Down to earth.

I got home from work.

Near the table in the dining room.

They heard him speak on the radio last night.

MAMA

TIP – TOP

FIFTY – FIFTY

THANKS

HUCKLEBERRY

BASEBALL PLAYER

Figure 2. *Stetler model*

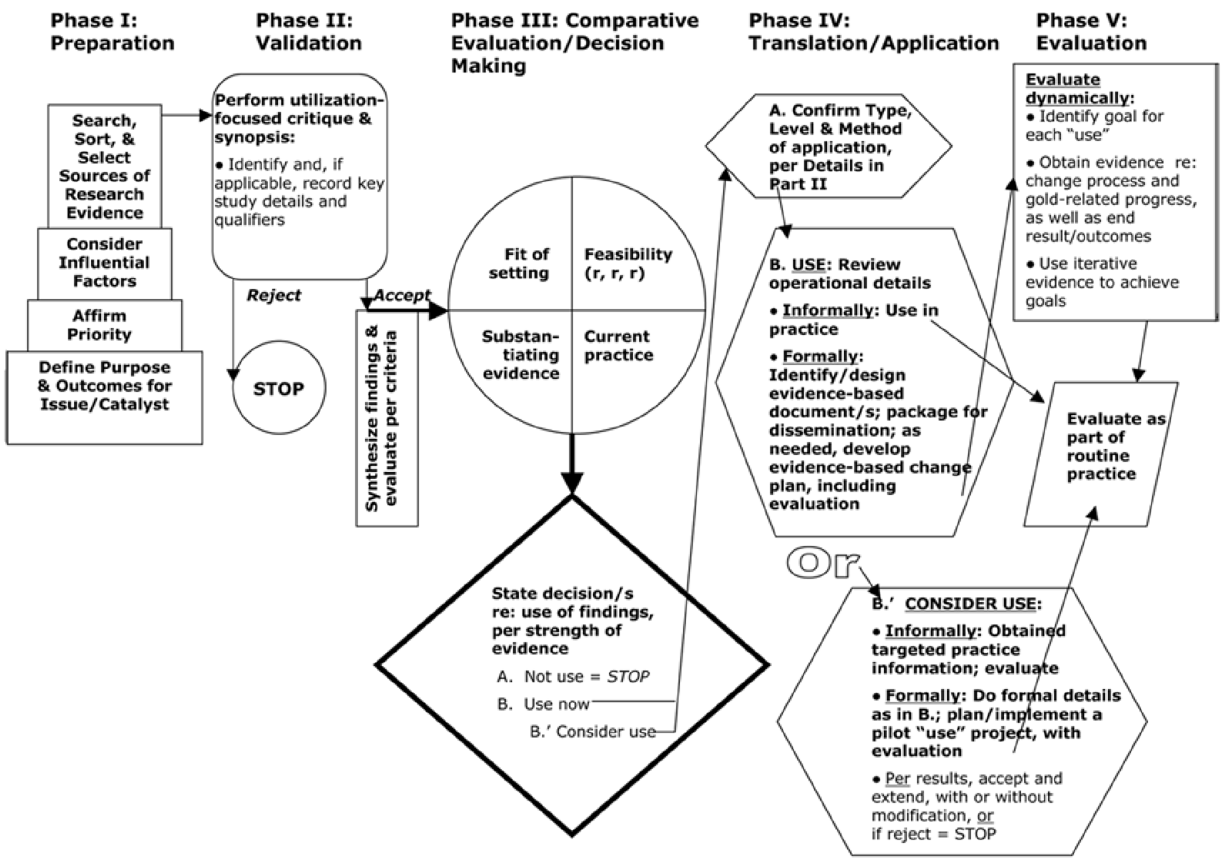

Figure 3. *Stroke coordinator roles*